Cumulative Risk Assessment: An Academic Perspective

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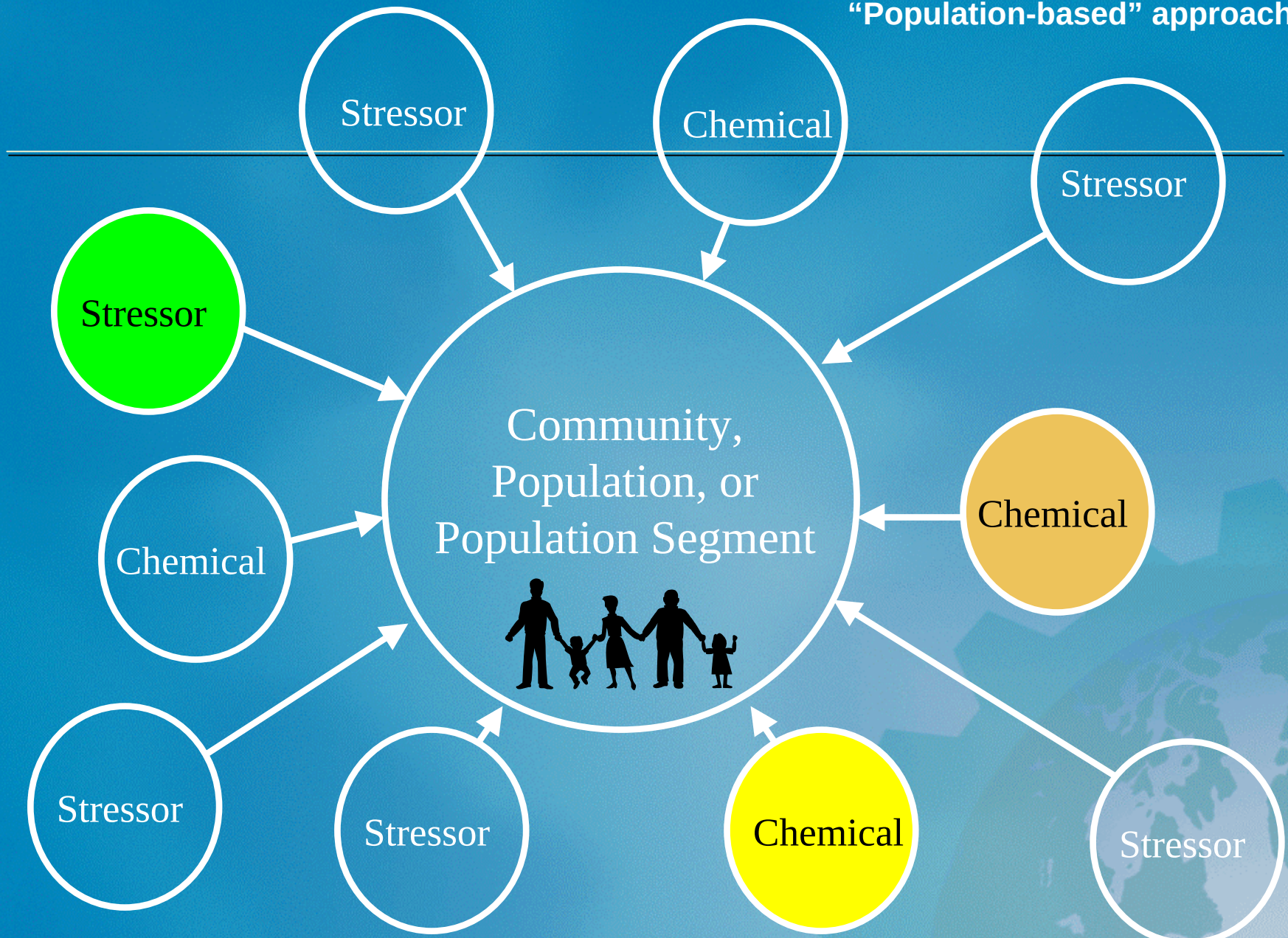
Defining Cumulative Impacts

- NEPA: "The incremental impact of the action, when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."
- A broader problem scoping and more comprehensive estimation of adverse effects can help refine potential alternatives and mitigation procedures.
- Includes:
  - Addresses long term sustainability of the resource including capacity to accommodate additional effects.
  - Increases actions unrelated (background exposures/vulnerabilities)
  - Includes direct and indirect impacts/stressors of action
  - Do not respect political boundaries
  - May last years beyond the action

“Population-based” approach



Types of cumulative effects

- Interactions (additive, synergistic)
- Mixtures
- Aggregate effects through a single or multiple mechanisms
- Acute/chronic or both
- Additive to background
- Direct/Indirect
- Single type or multiple types of stressors
- Often complex feedback loops that are poorly understood

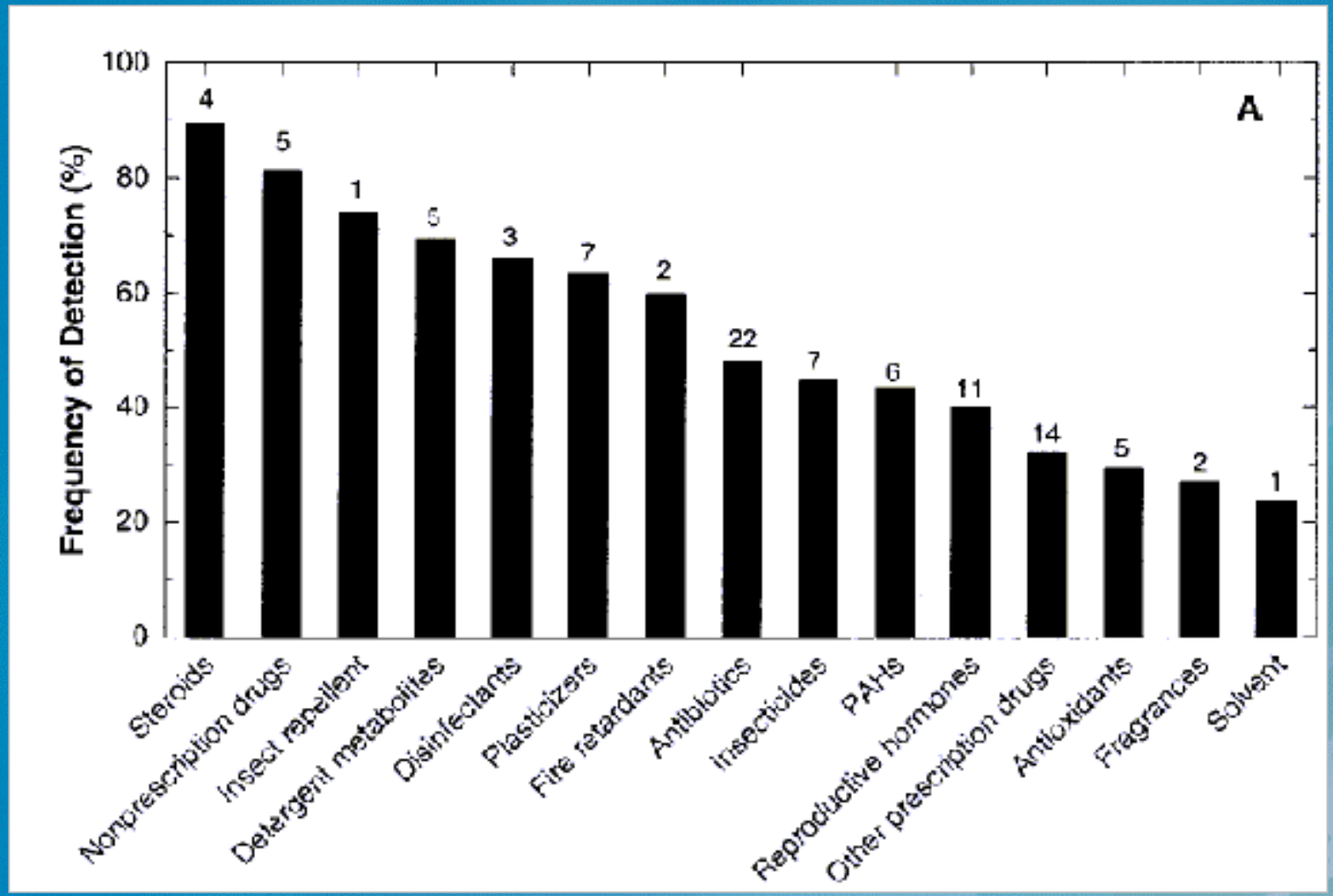
Areas where we have identified/are concerned about cumulative effects

- Poverty/nutrition
- Air contaminant mixtures (SO2/particulates)
- Lead and nutrition
- Stress, chemicals and heart disease
- Chemicals and immune suppression
- Sprawl, poor nutrition and obesity (also asthma)
- Global change – die-offs of predators, new conditions for vectors, increase in infectious disease
- Not enough research happening though – some progress

Problems for cumulative RA: lack of data

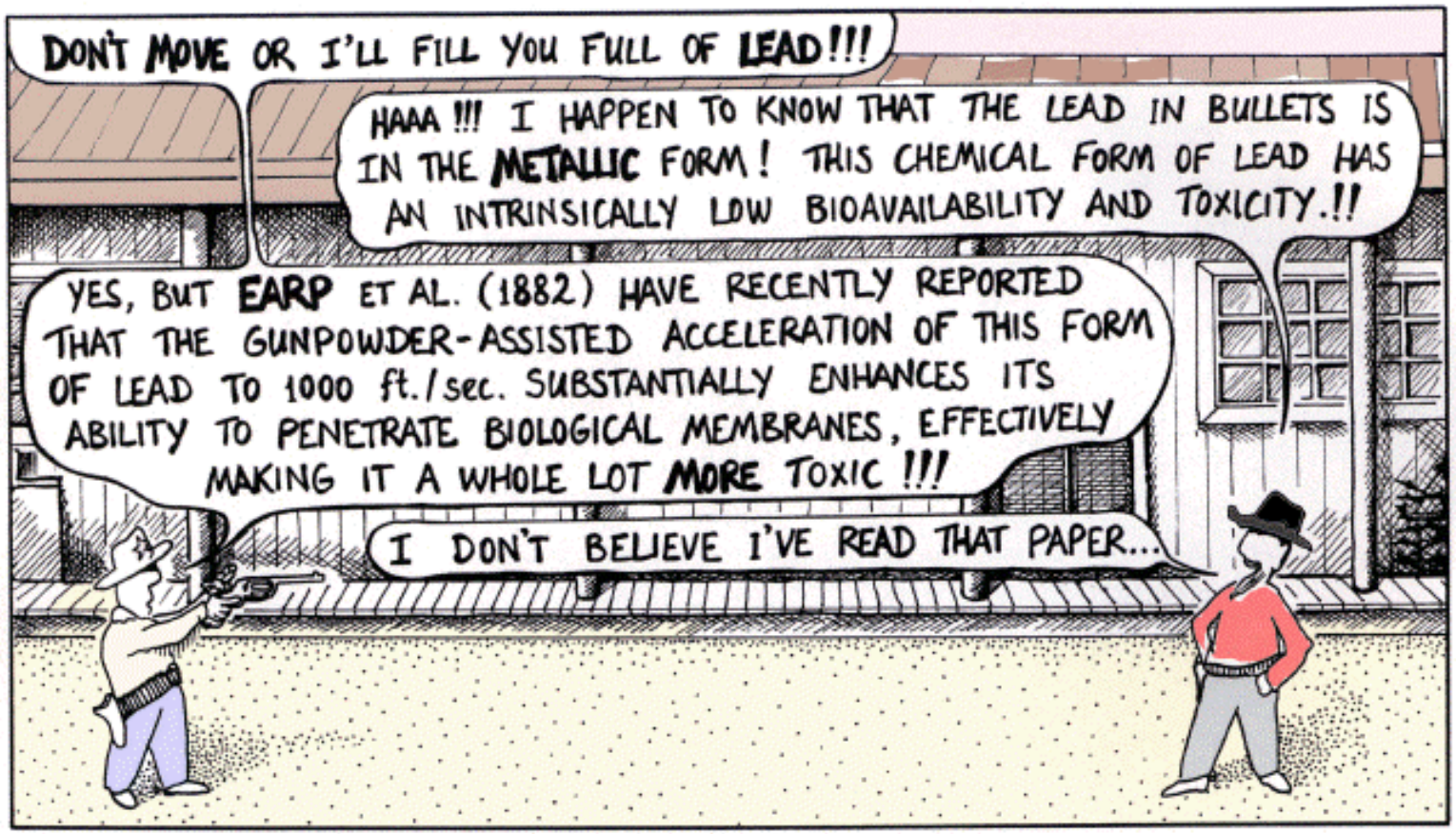
- Ignorance about chemical toxicity and effects of mixtures
  - Chemical toxicity data missing for most chemicals in commerce
- Data missing on exposures
- Poor health/disease tracking systems
- Default is lack of data, no problem

USGS Surveillance on Pharmaceuticals and Personal Care Products in the Environment



Lack of data compounded by limits in science and policy

- Lack of interdisciplinary approaches to find patterns in the evidence – focus on quantitative measures
- Lack of explicitness about uncertainties – what is known, not known, can be known, suspected
- Reactive focus- exposures are inevitable and there is some definable “acceptable” level of exposure that can be quantified – exposures generally considered safe until proven dangerous
- Slow process open to creation of uncertainty – years spent debating the nuances of a particular risk
- Traditional scientific and regulatory approaches often lead to “no problem”



ENVIRONMENTAL SCIENTISTS IN THE WILD WEST

“Unrecognized risks are still risks; uncertain risks are still risks; and denied risks are still risks.”

-- John Cairns, Jr.

Merrimack Valley Waste Facilities

- Concern about emissions from various closely situated waste facilities
  - DEP Focus on risk from each
  - Concern from communities about cumulative impacts
- DEP undertakes study: *Aggregate Impact Study for Inhalation Exposures to Air Toxics Emitted from Incinerators in the Merrimack Valley*
  - Considered aggregate air emissions from waste facilities
  - Did not consider food contamination
  - Did not consider other exposures, stressors
  - Concluded low risk but lots of uncertainty

MA DEP Science Advisory Board on Cumulative Effects of Waste Siting

- Regulated community asking why their industry and not others
- Focus only on air emissions – even difficult to get diesel exposure added in
- Regulators hesitant to use unless fully developed – "Currently these tools and methodologies have not been adequately developed for use in a regulatory context."
- Assumes need for more data before action can occur – for example need more accurate health data before can consider health indicators.
- "The Science Panel report recommended no clear next steps. As a result, no major changes to the impact assessment guidance are being made."

"It is neither good nor bad science to use all of the information available to protect the health of a potentially impacted community. No community member should be asked to presume that they and their families are safe because of scientific studies that have not yet been done."

What happened to prevention?

- Are we asking the right questions of problems? How bad it is versus how much can we prevent…
- TUR in MA example
  - Goal: 50% reduction in toxic waste
  - Focus on Ways to reduce waste and chemical use rather than “acceptable exposures”
  - Evidence but not proof of toxicity of chemicals on TUR list
  - Quantify materials used (why and how)
  - Understand costs of chemical use

Example: Toxics Use Reduction

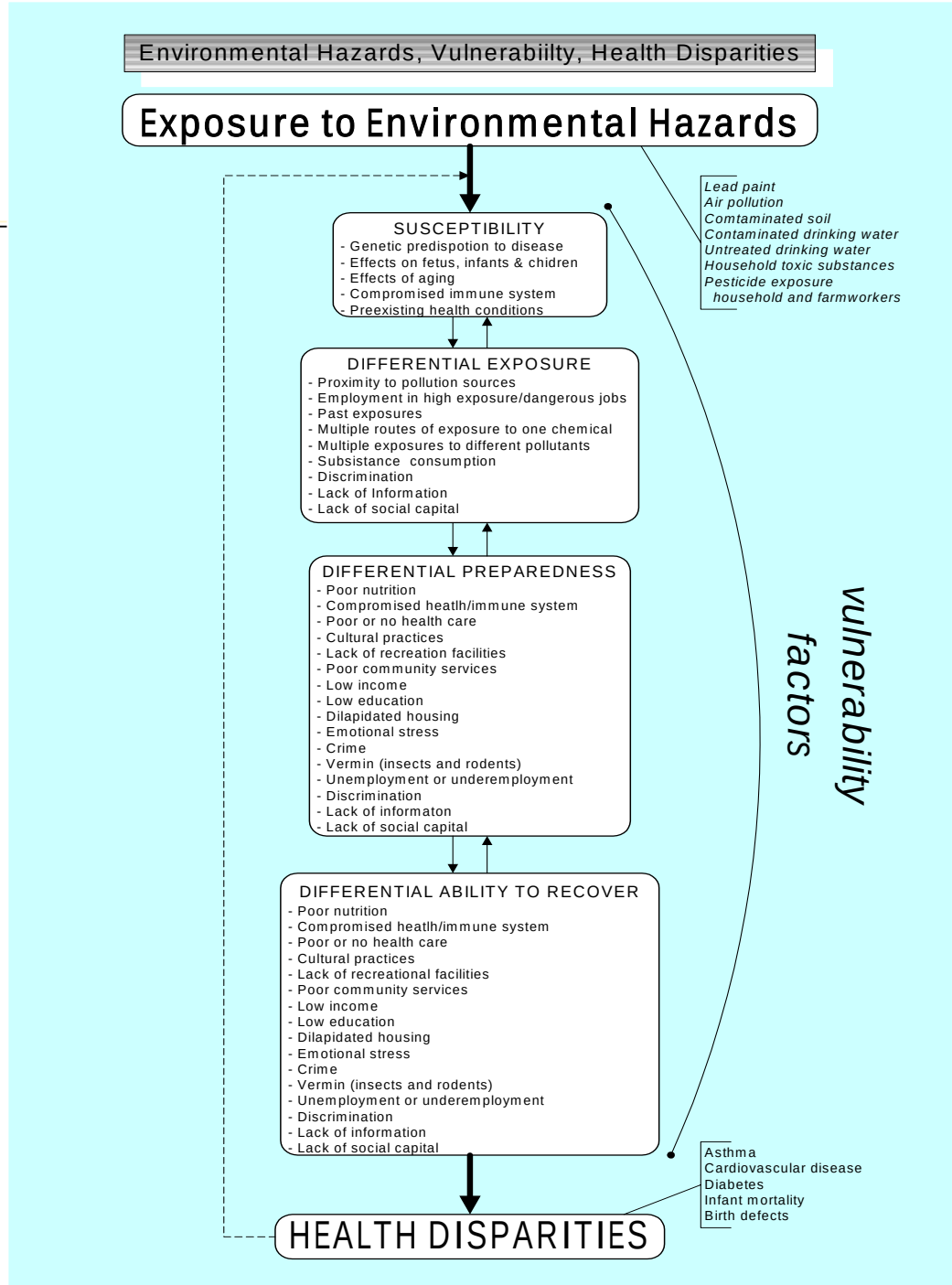
- Examine alternatives
- Innovation and technical support
- Measure progress and re-evaluate
- Results: 1990-2000
  - 60% reduction in waste
  - 40% reduction in use
  - 80% reduction in emissions
- Benefits to industry $15 million
- New areas: green chemistry, product design, green building, etc.

Example: Goal Setting/Foresight Planning

- Common in Public Health
- A holistic means for addressing cumulative effects.
- Goals for:
  - Reducing impacts/exposure
  - Phasing out materials
  - Materials efficiency
  - Disease reduction
- Backcasting to figure out means to achieve goals

Directions forward

- Understanding vulnerability factors – why are some people more vulnerable
  - Development of indicators – social, public health, age, genetic, of differential preparedness or ability to recover
    - Health tracking important for this
  - Exposure measures – understanding background exposures, cumulative exposures
  - Hazard measures
- Identifying red flag activities, hazards, situations, that could result in cumulative effects (metrics – number of facilities, toxics emitted, etc.)
- *Understanding economic, social, cultural, and scientific aspects of community risk*


Environmental Hazards, Vulnerabiilty, Health Disparities
Exposure to Environmental Hazards
Lead paint
Air pollution
Comtaminated soil
Contaminated drinking water
Untreated drinking water
Household toxic substances
Pesticide exposure
household and farmworkers
SUSCEPTIBILITY
- Genetic predispotion to disease
- Effects on fetus, infants & chidren
- Effects of aging
- Compromised immune system
- Preexisting health conditions
DIFFERENTIAL EXPOSURE
- Proximity to pollution sources
- Employment in high exposure/dangerous jobs
- Past exposures
- Multiple routes of exposure to one chemical
- Multiple exposures to different pollutants
- Subsistance consumption
- Discrimination
- Lack of Information
- Lack of social capital
DIFFERENTIAL PREPAREDNESS
- Poor nutrition
- Compromised heatlh/immune system
- Poor or no health care
- Cultural practices
- Lack of recreation facilities
- Poor community services
- Low income
- Low education
- Dilapidated housing
- Emotional stress
- Crime
- Vermin (insects and rodents)
- Unemployment or underemployment
- Discrimination
- Lack of informaton
- Lack of social capital
DIFFERENTIAL ABILITY TO RECOVER
- Poor nutrition
- Compromised heatlh/immune system
- Poor or no health care
- Cultural practices
- Lack of recreational facilities
- Poor community services
- Low income
- Low education
- Dilapidated housing
- Emotional stress
- Crime
- Vermin (insects and rodents)
- Unemployment or underemployment
- Discrimination
- Lack of information
- Lack of social capital
vulnerability factors
Asthma
Cardiovascular disease
Diabetes
Infant mortality
Birth defects
HEALTH DISPARITIES

Linking potential for cumulative impacts to prevention/precaution

- In absence of more developed assessment methods and indicators
  - Identify communities vulnerable for cumulative effects (poor, children, elderly, infirm)
  - Develop measures of when cumulative impacts may be occurring or could be significant (vulnerability, actions, or endpoints).
- Once evidence of potential or real cumulative impact identified, pass to prevention options analysis and prioritization.
- Need to characterize potential exposures and hazards
- Presence of illness (e.g., asthma) regardless of demonstrated link to activity should be enough
- Community involvement necessary at all points

Appropriate Science – A new vision of science for policy

- Methods/approaches chosen to fit the nature and complexity of the problem - flexibility
- Quantitative and qualitative data respected equally
- Risk assessment not separated from alternatives assessment (solutions)
- Use of interdisciplinary approaches
- More comprehensive uncertainty characterization and improved communication/ consultation
- Look at whole of evidence including accumulated knowledge and judgment
- Systems for continuous monitoring to identify early warnings

Conclusions

- Cumulative RA will not achieve its promise unless we move beyond the aggregate and risk-by-risk approach – is it the right tool?
- There will always be lots of uncertainty – acknowledge and move forward, include affected communities
- Need to develop quantitative/qualitative synthesis tools – QRA probably not the best
  - Move from Cumulative Risk to better means to characterize multiple stressors
- Need to develop good indicators and metrics
- We know they are multiple stressors are happening but can't always quantify them - need to focus on prevention as a priority